E/CONF.39/A/27
27 Sept. 1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: A. 3. 4. 1

South Africa

REDUCTION OF EVAPORATION LOSSES : A SUMMARY OF RESULTS OF TESTS IN SOUTH AFRICA

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REDUCTION OF EVAPORATION LOSSES. A. 3.4.1

A SUMMARY OF RESULTS OF TESTS IN SOUTH AFRICA.

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1. INTRODUCTION.

Preliminary tests were carried out at the Hydrological Research Division's experimental station in Pretoria using an existing battery of evaporation pans of various sizes and these were followed by tests on natural bodies of water situated in the semi-arid area near Kimberley.

2. TESTS OF PELLETS OF CETYL ALCOHOL.

Pellets of practically pure Cetyl Alcohol, manufactured to meet the specification of the C.S.I.R.O. of Australia for use in the raft method were tested by scattering various quantities on the surface of the water. The doses varied from sufficient alcohol to produce two monolayers up to sufficient to produce two thousand monolayers but in no case could any reduction in evaporation be detected.

The pellets were next tested in a standard raft (built in Australia according to the C.S.I.R.O. specification) in one of two 14 feet diameter evaporation pans 3 feet deep, the other pan being used as the control. The raft received a full charge of 2¼ lbs of pellets and (as it was floating on an area of 155 square feet instead of the 40,000 square feet for which it was designed) it should have produced a marked reduction in evaporation, but none was observed although the test continued for 16 days.

In order to test the quality of the Cetyl Alcohol, two grams of the pellets were dissolved in petrol and sprayed on the water in the control pan. During the next 48 hours the reduction of evaporation was 45 percent indicating that the quality was satisfactory. An examination of the floating pellets under a magnifying glass showed that they had been drawn completely under water by surface tension, thus preventing the release of molecules of alcohol so that no film could be formed.

3. APPLICATION OF ALCOHOL IN DIFFERENT STATES.

Cetyl Alcohol was applied in various states such as, large pellets, small pellets, flakes, fine powder and in solution, each set of tests being repeated several times, with the following results.

(a) The pellets failed to reduce evaporation.

(b) The flakes produced an average reduction of 17 percent over the first 48 hours.

(c) The powder and the solution behaved similarly and produced an average reduction of 40 percent, over the first 48 hours.

(d) In all cases, after 48 hours the rate of reduction fell and reached zero at four days after the application of the alcohol.

4. TESTS OF DIFFERENT TYPES OF FATTY ALCOHOL.

The relative efficiencies of several samples of pure cetyl alcohol (C.16) and commercial mixtures (C16-C18) were tested but very little difference in the behaviour was found, any small differences being in favour of the mixtures. The alcohol was applied as a powder or in solution.

5. THE EFFECT OF DAILY DOSING.

The tests mentioned in paragraph 3 showed that efficiencies fell off after 48 hours. The effect of daily doses was tested by applying alcohol (sufficient for 70 monolayers) each morning for nine days. During this test the rate of reduction remained fairly constant at an average of 43 percent.

6. FILM PRESSURE MEASUREMENTS.

Throughout these tests film pressures were measured by a light balance (using the ring method of measuring surface tension) which could be held in the hand while making measurements. This balance (The Roberts Film Pressure Balance) proved to be sufficiently accurate for its purpose, giving results within 5 dynes per cm. when used from a boat or on rippled water ; when used on the evaporation pans the results were within 2 dynes per cm. while in the laboratory results were within half a dyne/cm. Measurements in the evaporation pans showed that pressures of 35 to 40 dynes per cm. could be built up within an hour when using powder. These pressures persisted for 24 hours or so and produced a reduction of evaporation of about 45 percent. The pressures dropped to 20 dynes per cm. within 4 days and at this pressure there was no reduction of evaporation.

7. PRELIMINARY CONCLUSIONS.

At the completion of the preliminary tests at the experimental station the following conclusions were reached.

(a) The fatty alcohol should be applied as a finely divided powder or in solution.

(b) A fatty alcohol mixture (C16-C18) is as good as pure Cetyl Alcohol.

(c) Daily or continuous dosing is necessary.

(d) The maximum reduction of evaporation that can be expected under the best conditions is 45 percent if a fully compressed film is maintained continuously over the whole surface of the water.

8. FIELD TESTS.

Most of the field tests were carried out on a body of water 23 acres in extent which had been created by filling a dry natural depression. Reduction of evaporation rates could not be determined so the tests were limited to observing the behaviour of the films and the measurement of film pressures. Two of the tests are described.

9. THE EFFECT OF WIND ON A FILM.

A small quantity of alcohol in solution was sprinkled on the water near the up-wind edge of the depression. This formed an "island" of film which could be seen by its glassy appearance. Under the influence of the wind (600 feet per minute) the "island" moved slowly

across the water and it was observed that

(a) the leading edge moved at 30 feet per minute

(b) the trailing edge moved at 15 feet per minute

(c) the lateral spread was 3 feet per minute each way.

Film pressure measurement at the down wind edge of the water gave the following results

(a) Immediately after the arrival of the leading edge the pressure rose from 7 to 43 dynes per cm.

(b) Ten minutes later the pressure had dropped to 20 dynes/cm.

(c) Half an hour later all traces of the film had disappeared except for a line of spongy alcohol washed up on the beach indicating that most of the solution had been blown ashore before the solvent could evaporate.

10. FIELD TESTS WITH POWDER.

In one of these tests 90 lbs of powder were scattered over the whole area in very calm weather. On the following morning it was found that a film with pressures exceeding 25 dynes per cm. covered 22 percent of the surface, that 28 percent was covered by a film with pressure less than 25 dynes per cm. while the balance (50%) registered negligible pressures. The next morning, under the influence of a light breeze(one mile per hour) the film had moved across the water to the other side and had been reduced in area. This test indicated the difficulty in establishing a satisfactory cover even in calm weather, while other tests showed that films were blown off the water rapidly during windy weather.

11. FINAL CONCLUSIONS.

(a) Wind moves the film to the shore line and destroys it.

(b) There is very little lateral spread.

(c) The film does not spread against the wind.

(d) The whole of the film is never fully compressed.

(e) It is very difficult and costly to cover a natural body of water completely with a fully developed film so that there is little possibility of producing reductions of evaporation approaching any way near the 45 percent produced in the evaporation pans at the experimental station.

208 E - Oct. 1962 - 1, 500